

Application No. 09/438,955

REMARKS

New claims 18-29 are pending herein, original claims 1-17 having been canceled.

The title has been amended to more accurately reflect the invention of the pending claims.

The specification has been amended for clarity and consistency with the drawing.

In a separate letter to the Official Draftsperson, applicant proposes minor changes to the drawing to add reference numerals corresponding to the amendments to the specification.

No new matter has been added to the specification, drawing or claims.

New claims 18-29 have been added to the application in place of original claims 1-17 in order to more accurately define applicant's invention.

As is known in the art, VCSELs have an amplifying region enclosed by mirrors. One is a high reflectivity mirror and the other is a relatively low reflectivity mirror. The primary output light of the device is extracted through the low reflectivity mirror. In an ideal world, no light would pass through the high reflectivity mirror, but in practice some light leaks through and is normally lost.

In the prior art, this leakage light is blocked by the ohmic contact. The present invention depends on the inventor's insight that use can be made of this leakage light for monitoring purposes if the ohmic contact is made photon transparent, and various ways are disclosed for achieving this.

In other words, in the invention, the light used for monitoring purposes is the light leaking out of the "wrong" side of the device. In a top emitting VCSEL, this would be through

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the bottom, and in a bottom-emitting VCSEL, it would be through the top. The Examiner will note that the "bottom-emitting" VCSEL in Figure 3 is actually shown upside down. The bottom is actually the top in the Figure, but conventionally VCSELS that emit through the substrate are known as "bottom-emitting" VCSELS.

The original claims were rejected as indefinite and as either anticipated by or obvious over the Lin et al U.S. patent No. 5,838,708. Applicant courteously contends that the prior bases for rejection are rendered moot by the presentation of new claims 18-29.

Lin shows a VCSEL wherein the monitor light and primary light are output on the same side of the device. This is quite different from the invention and is highly disadvantageous because the presence of the monitoring device (PIN diode) in the output light will affect the performance of the laser.

Clearly, there is no teaching in the art of using the light leaking from the "wrong" side of the device for monitoring purposes. Absent such teaching, there would be no motivation for one skilled in the art to make the contact on this "wrong" side photon transparent, since light does not normally exit on this side. In fact, the recognition that some light will leak through the high reflectivity mirror, and that this leakage light can be used for monitoring purposes represents an important advance in the art. It permits the output of the laser to be monitored without affecting its performance, which happens when the monitoring device is put in the output light as taught by Lin. Indeed, Lin's teaching is directly contrary to the invention.

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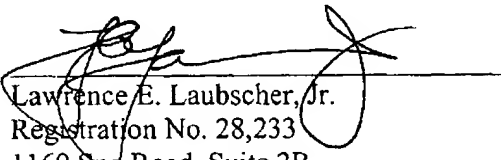
Allowance of new claims 18-29 is courteously solicited.

Should the Examiner deem that further amendments to the claims place them in even better condition for allowance, it is requested that he telephone applicant's representative at the telephone number set forth below.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Respectfully submitted,

October 7, 2002

  
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**OCT 07 2002**

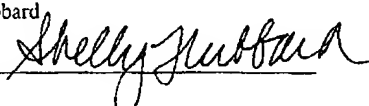
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I hereby certify that this correspondence consisting of 14 pages (including cover sheet) is being transmitted to GAU 2828 of the U.S. Patent and Trademark Office at facsimile No. 1.703.308.7722 on October 7, 2002.

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**In the specification:**

Page 1, the title has been amended as follows:

[BOTTOM EMITTING VCSEL (VERTICAL CAVITY SURFACE EMITTING LASER) WITH MONITOR EMISSION THROUGH TOP MIRROR] VCSEL WITH MONITOR EMISSION THROUGH HIGH REFLECTIVITY MIRROR

Paragraph beginning at page 2, line 31, has been amended as follows:

In Figure 2, a standard VCSEL is illustrated having an ohmic contact 20, a substrate 22 and a stack consisting of reflective mirrors, the high reflectivity mirror being denoted by the reference numeral 24 and the low reflectivity mirror being denoted by the reference numeral 26. Between the reflective mirrors is a light amplifying region 25.

Paragraph beginning at page 3, line 1 has been amended as follows:

As is known with VCSELs, one of the [two] mirrors reflects less (and transmits more) of the [light] incident [upon it] light from the amplifying region 25. The light transmitted through this less reflecting mirror is the light constituting the output light that is emitted by the VCSEL. This light is shown in Figure 1 by the arrow indicated by numeral 28.

\_\_\_\_\_ In the standard top-emitting VCSEL illustrated in Figure 2, light denoted by arrow 30 is lost as it is emitted into the substrate 22 below the bottom (high reflectivity) mirror 24 if it is not of a wavelength to which the substrate is transparent.

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\_\_\_\_\_ However, in a bottom emitting VCSEL, shown in Figure 3, where the light emitted through the less reflecting mirror 26 passes through a hole 32' forming a light output port in the substrate 22, nothing stops the light 28 that is transmitted through the high reflectivity mirror 24, except the ohmic contact 34 that is placed on the other side of that mirror. By providing an aperture 32 in the ohmic contact 34, it is possible to extract that light and monitor it with a [diode] photodiode (not shown) on which the VCSEL chip 14 can be placed.

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